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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Magnetic Separation Processes

We, STAMICARBON N.V., a Dutch Limited Liability Company, of 2 van der Maesenstraat, Heerlen, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the separation of magnetisable particles from contaminating non-magnetisable particles mainly larger than the magnetisable particles and present together with such magnetisable particles in suspension in a liquid.

Suspensions of fine magnetisable particles are employed as washing media in coal and ore washeries. Thus in such a washery the raw product may be separated into a specifically light and a specifically heavy fraction by means of a heavy medium formed by a suspension of magnetite or ferrosilicon in water. In such a process a suspension of the magnetisable particles is obtained by rinsing the separated fractions. This suspension is contaminated with fine particles of the original raw product which have to be removed before the suspension is reused. In most cases these contaminating particles are for the greater part larger than the magnetisable particles constituting the weighting material of the washing suspension, and the invention is therefore particularly relevant to the regeneration of such washery suspensions.

For the purpose of removing contaminating non-magnetisable particles from the suspension the latter may be supplied to a magnetic separator comprising a moving belt, drum or other conveying means to which the magnetisable particles are magnetically attracted, but as this procedure is at present carried out if the magnetic separator is worked at a reasonable capacity and a substantial quantity of non-magnetisable particles is present in the feed, an appreciable portion of these non-magnetisable particles are enclosed among the magnetisable particles retained by the magnetic separator. In consequence, if, e.g., the suspension rinsed from the separated products in a coal washery is treated in a magnetic separator in this way and the magnetic fraction is returned to the specific gravity separator, the amount of non-magnetisable particles returned is such that the viscosity of the separating medium in the specific gravity separator becomes too high to obtain a sharp separation at the required specific gravity. It has been proposed to classify the initial suspension of magnetisable and non-magnetisable particles and to treat the coarse and fine fractions separately in separate magnetic separators but this involves considerably higher costs for the plant.

The object of the present invention is to permit a good separation of the magnetisable and non-magnetisable particles to be performed in one magnetic separator.

According to the present invention there is provided a process for separating magnetisable particles from contaminating non-magnetisable particles mainly larger than the magnetisable particles and present together with such magnetisable particles in suspension in a liquid, said process comprising separating the suspension into fine and coarser fractions so that the solids content of the coarser fraction wholly or mainly consists of non-magnetisable particles larger than the magnetisible particles, and the solids content of the finer fraction wholly or mainly consists of magnetisable particles, and separating magnetisable and non-magnetisable particles of both fractions independently but simultaneously in one magnetic separator by feeding the fractions separately to spaced positions on the moving belt or other conveying means of the separator.

For the best results the classification of the suspension prior to the magnetic separation should obviously be made so that only a very small proportion of the magnetisable particles are present in the coarse fraction and only a

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very small proportion of impurities are present in the fine fraction. Preferably the fine fraction contains at last 80% of the magnetisable particles and the coarser fraction at least 80% of the impurities. The low concentration of magnetisable particles in the coarser fraction means that at the region of the magnetic separator where the magnetisable particles of this fraction are attracted by the magnets of the separator, comparatively few non-magnetisable particles are enclosed among the magnetisable particles, whereas at the region of the separator where the separation of the finer fraction is taking place the amount of impurities is small so that the amount of impurities enclosed among the magnetisable particles as this region of the separator is likewise small as compared with the results obtainable when the whole suspension is supplied to the same point of the separator.

Preferably the fine fraction is fed into the magnetic separator near the point where the magnetic fraction is discharged and the coarse fraction at a place more distant from this discharge point. In this case, each fraction may be distributed over the full width of the separator. However, as an alternative the fine and coarse fractions may be fed to side by side positions across the width of the magnetic separator. In this case the fractions may be kept separated from each other by means of a partition wall.

The content if impurities in the fine magnetic fraction may easily be kept sufficiently low to make it unnecessary to wash this fraction on the belt or other magnetic element of the magnetic separator for the purpose of reducing the content of impurities. As a result, the magnetic fraction can be recovered in a concentrated state, so that e.g., in a coal washery, the magnetic fraction can be returned directly to the main specific gravity separating apparatus without treatment in a thickener.

The invention is further explained with reference to the diagram of a coal washery shown in the drawing.

In the separating apparatus 1 raw coal is separated by means of a magnetic suspension into washed coal and shale. The coil to be washed is fed into the separating apparatus at A, the separated coal and shale fractions leaving the apparatus at B and C respectively togther with an amount of separating suspension. The separated fractions are led over screens 2, where the suspension has the opportunity to drip from these fractions. This suspension, which has the same specific gravity as the suspension in the separating apparatus, is collected in a tank 3 and returned to the separating apparatus 1 by a pump 4.

Subsequently, the separated fractions are led across screens 5, where they are sprayed with clarified and next with clean water by the sprayers 6 and 7 in order that the adhering suspension may be removed, after which the washed coal and shale are discharged at D and E respectively. The screens 2 and 5 are, e.g., vibrating screens with a mesh of 1 mm.

The dilute suspension passing through the screens 5 is collected in a tank 8 and from there supplied, by means of a pump 9, to a curved screen 10 composed of assembled spaced bars where the particles in the dilute suspension are separated into fractions of different sizes by a method claimed in our co-pending Application No. 37323/54 (Serial No. 791,520). The width of the slots between the bars is 0.5 mm and the underflow from the screen contains, in addition to liquid, substantially only particles of a size smaller than about half of the slot width, i.e., of a size smaller than 0.25 mm. About 90% of the liquid flows through the slots and as the magnetite is smaller than 100μ, 90% of the magnetite is consequently collected in the collecting tank 11 under the screen. The overflow from the screen 10 contains the coarser non-magnetic particles and 10% of the magnetite suspension and the fine impurities.

Both the underflow and the overflow of the screen 10 are fed directly into a magnetic separator 12, the direction of rotation of which is shown by the arrow in the drawing. The underflow of the screen 10 is fed into the tank 18 under the magnetic separator, near the discharge point where magnetite particles attracted to the drum by the magnets 19 leave the tank and are discharged from the drum. The content of non-magnetic particles in the underflow is so low that the magnetite fraction discharged from the separator is very pure. The overflow of the screen 10 is led into the tank at the opposite end where the drum surface travels into the tank. Here the coarse impurities can immediately settle without being hindered by the presence of large amounts of magnetite. The magnetite attracted by the magnets 19 from the coarse fraction is, consequently, practically free of non-magnetic particles.

The high impurity of the magnetite fraction held on the drum of the separator makes it unnecessary to rinse the drum for removing impurities so that the magnetite fraction is discharged in concentrated condition (specific gravity about 2.1) and is pumped to the collecting tank 3 by a pump 13. On its way the suspension may be led through a demagnetizing coil 14. If the main specific gravity separating apparatus 1 consists of one or more cyclones it is, however, not necessary to demagnetize the suspension. The suspension is then pumped to the separating apparatus, together with the suspension from the drainage screens 2 which was also led into the collecting tank 3. As an alternative the magnetite suspension recovered in the magnetic separator 12 may be pumped directly to the separating apparatus 1. In both cases the specific gravity of the suspension fed into the separat-

ing apparatus will be higher than the specific gravity desired for the treatment in the said apparatus which is, e.g., 1.6. The specific gravity may be simply adjusted to the desired value by supplying the correct quantity of water at G.

In the magnetic separator 12 a dilute non-magnetic fraction is recovered, which is led into a collecting tank 15 and thence by means of a pump 16 into a hydrocyclone 17, where the impurities are removed. The clarified overflow fraction from this hydrocyclone is led to the sprayers 6, to serve as washing water, while the discharge fraction F of the hydrocyclone is removed from the system and may be subjected to further treatment, e.g. in a froth flotation plant.

As an alternative to the use of the wet screening method claimed in co-pending Application No. 37323/54 (Serial No. 791,520) for separating the suspension into fine and coarse fractions prior to the magnetic separation, the fractions may be separated by wet screening on a curved perforated plate as claimed in Claim 1 of co-pending Application No. 37324/54 (Serial No. 791,857) or by wet screening on a flat screening deck as claimed in Claim 1 of co-pending Application No. 3222/55 (Serial No. 791,858) or 5125/55 (Serial No. 791,859).

WHAT WE CLAIM IS:—

1. A process for separating magnetisable particles from contaminating non-magnetisable particles mainly larger than the magnetisable particles and present together with such magnetisable particles in suspension in a liquid, said process comprising separating the suspension into fine and coarse fractions so that the solids content of the coarser fraction wholly or mainly consists of non-magnetisable particles larger than the magnetisable particles, and the solids content of the finer fraction wholly or mainly consists of magnetisable particles, and separating magnetisable and non-magnetisable particles of both fractions independently but simultaneously in one magnetic separator by feeding the fractions separately to spaced positions on the moving belt or or other conveying means of the separator.

2. A process according to Claim 1 wherein the fine fraction is fed to the magnetic separator near the position where the magnetic fraction is discharged and the coarser fraction is fed to the separator at a position more distant from the discharge point.

3. A process according to Claim 1 wherein the coarse and fine fractions are fed to the magnetic separator at side by side positions across the width of the separator.

4. A process according to any preceding claim wherein the suspension is separated into the coarse and fine fractions by wet screening according to the method claimed in Claim 1 of any of co-pending Applications Nos. 37323/54 (Serial No. 791,520), 37324/54 (Serial No. 791,857), 3222/55 (Serial No. 791,858) and 5125/55 (Serial No. 791,859).

5. In a coal washery employing a suspension of magnetisable particles as washing medium, the method of recovering magnetisable particles for reuse in the specific gravity separator substantially as described with reference to the accompanying drawings.

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887491 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*